

would be necessarily existing in the normal carbide condition.

Turning to the vexed question of nomenclature, the chapter on what M. Osmond calls the distinct constituent "sorbite" will hardly convince those who regard this substance as merely the first of three phases of pearlite. On p. 87 the author says, concerning sorbite:—

"Often very fine and deep lamellæ of cementite are found which are more or less continuous: this is what Fig. 45 (polish-attack $\times 1500$) ought to show, if the feebleness of the original photograph has been sufficiently reproduced, which is doubtful."

The reviewer does not pretend to grasp the meaning of this paragraph, unless owing to faulty translation the word feebleness has been substituted for delicacy. The following lines on p. 91 are also obscure; referring to sorbite M. Osmond says:—

"In the first edition of this work I did not give with sufficient clearness, ideas which were perhaps slightly confused."

With reference to "martensite," which M. Osmond calls "the fourth constituent," many metallurgists hold that it is a crystalline structure found in both hardened and unhardened steels, and hence cannot be a constituent.

It is stated by Mr. Stead in his preface that the special appendix on what M. Osmond calls the constituent "austenite" renders the work complete. On p. 39, Fig. 20, is figured in an excellent photomicrograph a pale substance stated to be austenite, and a dark substance which is called martensite. Carbonists, however, hold that the pale areas are hardenite containing dissolved cementite, the dark areas being a mixture of hardenite and free cementite (M. Osmond's methods are evidently not sufficiently delicate to detect in the dark so-called martensite the constituent last named). On etching, the hardenite with the free cementite assumes the anode position, but the areas of hardenite with the dissolved cementite assume the kathode position, and are hence unacted upon.

In the appendix on "austenite," a 1.55 per cent. carbon steel was evidently annealed in iron ore until the surface carbon was reduced to 0.35 per cent., the middle still remaining at 1.55 per cent. The composite mass was then quenched, polished and scratched with a needle. M. Osmond then found that the 0.37 per cent. region was harder than the 1.55 per cent. region, and hence that "austenite" is soft. No proof is given that in the high carbon region the separation of graphite had not been brought about by the annealing. However, no practical steel metallurgist can believe that a 0.37 per cent. carbon steel, rapidly quenched from 1050° , is harder than a 1.55 per cent. carbon steel quenched under the same conditions, because it has been frequently established that the latter will scratch quartz (7) and the former only apatite (5).

Concerning hardness, M. Osmond says on p. 83 that cementite has a hardness of 6 (felspar), and is harder than quenched steel. It is well known to mineralogists that the best classes of pen-knife blades (*which have been tempered*) have a hardness of 6 to

6.5, and that fully hardened steel has a hardness at least equal to that of quartz (7).

In connection with micrographic definitions it is interesting to note that within a year two books dealing with the microstructure of metals have been published by prominent members of the allotropic school, namely, the work under review and one by Prof. Howe.

It will be well here to quote the respective definitions given as to the nature of austenite.

Osmond (p. 98).—"To obtain it" (austenite) "the temperature of the steel must be above 1000° and the temperature of the quenching bath a little below, or just at, 0° C., and the proportion of carbon must exceed 1.1 per cent."

Howe, "Iron, Steel and other Alloys" (p. 179).—"Austenite, the characteristic and chief constituent of suddenly cooled, *i.e.* 'hardened' steel, is a hard, brittle mass, with a needle-like structure, and is a solid solution of carbon in iron, the proportion of carbon varying from nothing up to about two per cent."

Of allotropic definitions, students of metallography, somewhat modifying the words of Enobarbus, may well say:—

"Truth cannot wither them, nor custom stale
Their infinite variety."

Also Prof. Howe's reference to "a solid solution of carbon in iron" containing no carbon seems distinctly Hibernian.

All students should obtain M. Osmond's book. His brilliant and valuable thermal work and the charm of his ingenuous writings have made him many friends amongst those who strenuously oppose his theories and nomenclature. His book gives a fairly clear enunciation of his views, which are now accessible to all, whereas before they had been fully set forth only to those familiar with his original memoirs in French; nevertheless, a perusal of his book will reveal to many metallographists the fact that his patient work has been carried out in an environment perfectly detached from the stern actualities of the great world of practical steel metallurgy.

J. O. ARNOLD.

ZOOLOGICAL ESSAYS.

Mostly Mammals. Zoological Essays. By R. Lydekker. Pp. ix+383; with sixteen full-page illustrations by the Duchess of Bedford, Lord Delamere, the Hon. Walter Rothschild, J. Wolf, and others. (London: Hutchinson and Co., 1903.) Price 12s. 6d.

THOSE who already know these zoological essays will welcome their re-publication in book form; those who have not previously discovered them in periodical literature may be envied their treat in store. For the essays are at the high-water mark of zoological exposition; they are vividly interesting, yet scrupulously accurate; they are rich in fresh facts, salted with big evolutionary ideas. The author is well known as one of the foremost experts on mammals, and he has exhibited for many years the great gift of discussing difficult problems "popularly," without blunting the edge of his scientific thoroughness.

Some of the essays discuss man's influence in ex-

termination and in domestication. We are reminded that the nineteenth century, so progressive for zoology, is responsible for many sad exterminations, in some of which man has played a careless part. The possibilities of adding to the list of domesticated animals are discussed, but the result of this interesting inquiry is not encouraging: it may be that the elephant and zebra will yield to domestication in Africa; the number of herbivores capable of acclimatisation in parks can be greatly increased, but the secret of domestication seems to have been lost as civilisation was gained, and no new additions of importance can be looked for with any confidence. It almost seems as if our ancient forbears had exhausted the possibilities. This naturally leads to a discussion of the origin of domesticated mammals, in the course of which it is confessed that we are unable to point to the ancestral stock of the sheep, and that there is great uncertainty in regard to the horse. The breeds of goats seem to be derived from the Persian pasang, the donkey seems referable to a Somaliland wild ass, and it is maintained, perhaps too dogmatically, that the numerous breeds of domesticated cattle in Europe all trace their ancestry to the great extinct wild ox, or aurochs. The difficult problem of extermination recurs in an essay on "A Land of Skeletons"—Argentina, once the headquarters of glyptodonts, mylodons, megalotheres, and other splendid giants, which died off one after another through the long ages during which the mud of the Pampa was accumulating. Here man cannot have been the eliminating factor, but what the "death-bringing shackles" were we do not know.

For another group of essays the key-word is *distribution*. The marked individuality of the fauna of Celebes, the possibility of a previous land-connection between South America and Australasia, the characteristics of the African fauna, the inhabitants of deserts, are among the subjects discussed. Opportunity is found to correct the still lingering belief that deserts are uninterrupted plains of smooth sand, originally deposited at the bottom of the sea, from which they have been raised at a comparatively recent epoch.

"It may be laid down as a general rule that the greater the amount of sand to be found in a desert, and the greater the difference between the animals inhabiting that desert from those dwelling in the adjacent districts, the greater will be the antiquity of the desert itself. In the case of a desert forming a complete barrier across a continent, like the Sahara, if the animals on one side are quite different from those on the other, its antiquity will be conclusively demonstrated."

In another group of essays we have illustrations of the light which past history sheds upon the present. Thus Mr. Lydekker discusses some extinct Argentine mammals, such as the "ground-sloths," some of which "appear to have been kept in caves as domesticated animals by the ancient inhabitants of Patagonia" (!); the armour-clad whales, such as *Zeuglodon*, the characters of which point to an affinity between toothed whales and carnivores; the ancient hippopotamuses; and the prehistoric cats and dogs.

Coloration is the key-note of another group of

essays. Protective coloration in large animals is illustrated by the Somali giraffe (well shown by one of Lord Delamere's photographs of a giraffesque thicket), by Grévy's zebra, and by many deer; but the point is emphasised that in many other cases, such as the males of the Indian blackbuck, of the white-eared kob, and of the banting, no quite satisfactory reason can be assigned for the development of the characteristic colouring. This discussion naturally leads on to the essay which deals with stripes and spots in mammals, in regard to which it is shown that, while there may be a substratum of truth in the late Prof. Eimer's "longitudinal-spotted-transverse-uniform" theory, it does not cover the facts. Thus transverse stripes appear in some of the most primitive of all mammals, and reappear in certain specialised groups where there is no evidence of a previous spotted stage having been passed through. From this theme we are led on to a discussion of "How Arctic Animals Turn White," in connection with which the importance of Metchnikoff's researches on the rôle of phagocytes in the blanching of hair is recognised. As to the protective value of the blanching there is no doubt. Under the striking title "An Invisible Monkey," Mr. Lydekker describes the remarkable black and white coloration of the guerezas (*Colobus*), which harmonises with the black-barked boughs thickly draped with pendent masses of grey lichen. "As the monkeys hang from the branches," writes Dr. Gregory, "they so closely resemble the lichen that I found it impossible to recognise them when but a short distance away." Another essay is devoted to the peculiar hair of the sloths, where resemblance to a lichen-clad knot is enhanced by a growth of green algæ on the hairs. A more difficult subject is the coloration of cowries, some lines in the manifold evolution of which the author tries to decipher. That banding was the original type seems to be indicated by the fact that it prevails in the young of the great majority of species.

Other essays discuss monkeys' noses and hand-prints, the aye-aye and the flying squirrels, the beaver, the quagga, cave-animals, giant land-tortoises, nursing habits of amphibians, scorpions and their antiquity. The only fault we wish to find with this delightful volume is that we can detect no arrangement in it, though, as our review shows, some grouping is readily possible.

Zoologists will find much valuable material in this volume, and many suggestions which are evidently not *obiter dicta* but the outcome of an expert's reflection. But the author's power of carrying the reader with him from the familiar to the unfamiliar should make his book welcome to a wider circle—to all interested in the problems of natural history. Our conviction is that there is much more education to be got out of a book like this, if read as carefully as it has been written, than out of many a treatise on mammals. It introduces the student to actual problems and to the method which an expert pursues in studying these. In conclusion, we would direct attention to the beautiful illustrations, e.g. of the aye-aye, of giraffes in covert,

of the white-tailed guereza, of a Peking stag, of Père David's Mi-Lou deer, and of the giant tortoise of South Aldabra Island. We hope that this book, which is as stimulating as it is informative, and is far and away above most "popular" natural history essays in its thoroughness, accuracy, and suggestiveness, will have the wide circulation it deserves, and that the author will continue to enrich our scientific literature with many more "zoological essays."

J. A. T.

INFECTION AND IMMUNITY.

Infection and Immunity, with Special Reference to the Prevention of Infectious Diseases. By George M. Sternberg, M.D., LL.D., Surgeon-General U.S. Army (Retired). Progressive Science Series. Pp. ix+293. (London: John Murray, 1903.) Price 6s. net.

IN the preface to this volume we find the general statement that "all infectious diseases are preventable diseases," and with this proposition, at least in a general sense, we heartily concur. It follows that there can be no more important factor in the extermination of infectious diseases than the education of the public in their essential nature and modes of spread. For with such knowledge comes not only increased personal precaution against infection, but what is even more important, an enlightened tolerance of sanitary legislation. A volume on "infection and immunity" is thus most suitable for such an undertaking as the Progressive Science Series, and the editor has been fortunate in securing the services of Dr. George M. Sternberg as an expositor of the subject. Dr. Sternberg is well known as one of the pioneers of American bacteriology; he has taken a prominent part in the advancement of public health, and, in particular, of military hygiene in that country; disinfection is, moreover, one of the subjects with which his name is especially associated.

As befits the series to which it belongs, the book is written for the non-medical public, and the writer expresses the hope that it may serve as a text-book for those responsible for the sanitary welfare of public institutions, and even for high schools and colleges. It is divided into two parts, the first of which deals with the general principles of the subject, while the second is devoted to the chief infectious diseases in detail.

The general part contains thirteen short chapters. After a definition and explanation of what is meant by infectious disease, the nature of "disease germs" receives somewhat short treatment. The chapter on "channels of infection" is excellent, and gives a clear idea of the ways in which different diseases spread. Equally good is the chapter on susceptibility to infection, and this is followed by a series of chapters on disinfection and the different agents by which this can be brought about, such as heat, chemicals, and the like. The action of these agents is clearly explained. This part of the book is brought to a close by three short

chapters on immunity and antitoxins. The author is probably wise in having omitted, in a popular work, all discussion of Ehrlich's fascinating theory of the origin of "anti-bodies."

It appears to us that Dr. Sternberg has done this part of his work well, and has furnished a very adequate and readable account of the subject, but it is permissible to doubt whether, in his effort to be concise, he has always made sufficient allowance for the extraordinary ignorance which undoubtedly exists in the mind of the average man as to the essential nature of bacteria and other disease germs. He deals with this matter, which it must be remembered lies at the very root of his whole subject, in five short pages, in which we fail to find any reference whatever to the size of the objects he is describing. Yet it is this very matter of size which is so great a stumbling-block to the average mind in forming a conception of the nature of infection. It would, in our opinion, have been well, in a book which is intended as a text-book for students in high schools and colleges, to have devoted a much larger space to elementary information as to the essential nature of disease germs. In spite of the great accuracy which marks the majority of the writer's statements, there are one or two to which it is possible to take exception. On p. 12 we read that "tetanus is the only disease of man in which spores have been demonstrated"; there are other anaërobic sporeformers which produce disease in man, e.g. *Bacillus oedematis maligni* and *B. aerogenes capsulatus*, while anthrax is unfortunately far from unknown as a human affection. Again, on p. 41, it is stated that alcohol has scarcely any germicidal power; it is true that alcohol cannot kill bacterial spores, but it is almost instantaneously fatal to non-spore-forming bacteria, at least when these are in the moist condition. These, however, are small blemishes upon what is, on the whole, a very excellent account of a difficult and complex subject.

When we turn from the general to the special part of the book, which occupies another twenty chapters, it is difficult to find anything which is not worthy of unstinted praise. The different infections are taken seriatim, and under each disease we find an admirable and lucid account of its epidemiology and history, of what is known as to the germ which causes it, of the channels by which it spreads, and of the precautions to be taken in combating it. The only important human infectious disease which is omitted is anthrax, if we except syphilis and gonorrhœa, which, from motives of, we think, mistaken delicacy, have been altogether excluded from the book. The author naturally draws much of his statistical information from American sources, and some of it will probably be novel to English readers; for instance, the striking connection between toy pistols and tetanus which has been observed in the United States. The typhoid statistics of American cities will also be viewed with a chastened satisfaction in view of our own more favourable figures, save only for Belfast. It may be regretted that, in treating of diphtheria, Dr. Sternberg has not laid more stress on the importance of